

CLAIMS

What is claimed is:

1. A concentrate adapted to be diluted with a diluent polymer to produce a corrosion inhibiting composition effective to protect a ferrous metal surface against corrosion in a molecular-oxygen containing atmosphere containing in the range from 1 to 100 ppm of an acid gas at a relative humidity of 90% and 37.4°C (100°F), when the surface is exposed in generally spaced apart relationship with the composition in a sealed environment, the concentrate consisting essentially of a substantially non-hydrolyzable synthetic resinous polymer having dispersed therein from 10 to about 40 parts of an interceptor selected from the group consisting of an alkali metal silicate and zinc oxide, from 10 to 40 parts of sodium nitrite and from 10 to 40 parts of a 2,4,6-tri-substituted phenol having a 4-substituent selected from the group consisting of a substitutable methylene carbon and a substitutable amine, in combination with an adjuvant present in less than 5 parts, provided that the polymer has a water vapor transmission rate (WVTR) at least as high as that of low density polyethylene, and is present in an amount of at least 40 parts in 100 parts of the composition.
2. The concentrate of claim 1 wherein the polymer is miscible in the diluent polymer selected from the group consisting of low density polyethylene, polypropylene, copolymers of lower C₂ - C₈ olefins, copolymers of a lower C₂ - C₈ olefin and ethylene/vinyl alcohol, non-biodegradable polyester, poly(vinyl chloride), polystyrene, polyamide, and a biodegradable polyester having a WVTR higher than about 1.5 gm/24 hr measured per 0.025 mm (mil) thickness and 645 cm² (100 in²) area at 37.4°C (100°F) and 90% RH (relative humidity).
3. The concentrate of claim 2 wherein the diluent polymer is a biodegradable polyester selected from the group consisting of star ε-caprolactone, ε-caprolactone (PCL); poly(hydroxybutyrate-co-valerate) (PHBV), containing 8, 16 and 24% valerate; uncoated- and nitrocellulose-coated cellophane films; crosslinked chitosan;

starch/ethylene vinyl alcohol (St/EVOH) blend films; pure EVOH film (38 mole percent ethylene); and polycaprolactone (PCL), molecular weight about 80,000 Daltons.

4. The concentrate of claim 2 wherein the 2,4,6-tri-substituted phenol is selected
5 from the group consisting of 2,6-di-t-butyl-4-methylphenol;
2,2'-methylene-bis(4-methyl-6-t-butylphenol);
1,1,3-tris(2'-methyl-4'-hydroxy-5'-t-butylphenyl)butane; 1,3,5-tris(3',5'-di-t-butyl-4'-
hydroxybenzyl)-2,4,6-trimethylbenzene; tris((3-(3',5'-di-t-butyl-4'-hydroxybenzyl)-
2'acetoxyethyl))isocyanurate; and,
10 pentaerythrityl-tetrakis(3,5-di-t-butyl-4-hydroxyphenylpropionate).
5. The concentrate of claim 1 wherein the alkali metal silicate is a silicate of
sodium and the adjuvant is selected from the group consisting of fumed silica and
calcium carbonate.
6. The concentrate of claim 2 wherein the adjuvant, the interceptor and the
15 sodium nitrite have a primary particle size in the range from about 1 μm to 53 μm and
are substantially homogeneously dispersed in the polymer.
7. An article of arbitrary size and shape made of substrate polymer consisting
essentially of a substantially light permeable film of synthetic resin having
substantially uniformly dispersed therein a combination of volatile corrosion inhibiting
20 ingredients including an interceptor selected from the group consisting of zinc oxide
and a silicate of an alkali metal, each present in an amount from 0.01 to 2% by weight
of the film; 0.01 to 2% of sodium nitrite; from 0.01 to 2 phr of a 2,4,6-tri-substituted
phenol having a 4-substituent selected from a substitutable methylene carbon and a
substitutable amine; and from 0.01 to 1% of an inert adjuvant having a hardness
25 greater than that of the sodium nitrite; wherein the silicate, the sodium nitrite and
adjuvant each have a primary particle size in the range from 1 μm to 53 μm , and the

resin after exposure to an atmosphere including molecular oxygen and from 1 to 100 ppm of an acid gas at a relative humidity of 90% and 37.4°C (100°F) for more than 24 hr, has a water vapor transmission rate (WVTR) which is substantially the same as that of the resin without the volatile corrosion inhibiting ingredients.

5 8. The article of claim 7 wherein the film is of a lower olefin having from 2 to 8 carbon atoms, the film having smooth upper and lower surfaces, and a thickness in the range from 0.0125 mm (0.5 mil, or 0.0005") to 0.125 mm (0.005" or 5 mil); and, the inert adjuvant is an inorganic dispersant selected from the group consisting of fumed silica and calcium carbonate.

10 9. A hollow capsule having walls of a first substantially non-hydrolyzable synthetic resinous polymer containing macrogranules of a corrosion inhibiting composition consisting essentially of a second substantially non-hydrolyzable synthetic resinous polymer having dispersed therein from 10 to about 40 parts of an
15 interceptor selected from the group consisting of an alkali metal silicate and zinc oxide, from 10 to 40 parts of sodium nitrite and from 10 to 40 parts of a 2,4,6-tri-substituted phenol having a 4-substituent selected from the group consisting of a substitutable methylene carbon and a substitutable amine, in combination with an
20 adjuvant present in less than 5 parts, wherein each first and second substantially non-hydrolyzable synthetic resinous polymer may be the same or different, and provided that each polymer has a water vapor transmission rate (WVTR) at least as high as that of low density polyethylene, and is present in an amount of at least 40 parts in 100 parts of the composition.

25 10. The capsule of claim 9 wherein the walls are formed of a polymer selected from the group consisting of a film of a lower olefin having from 2 to 6 carbon atoms and a foam of substantially non-hydrolyzable polymer.

11. The capsule of claim 10 wherein the WVTR of each first and second polymer is higher than about 1.5 gm/24 hr measured per 0.025 mm (mil) thickness and 645 cm² (100 in²) area at 37.4°C (100°F) and 90% RH (relative humidity)

12. A method of thermoforming a synthetic resinous polymer having dispersed
5 therein a combination of volatile corrosion inhibiting ingredients comprising,
forming macrogranules of a first polymer having dispersed therein from 10 to about 40
parts of an interceptor selected from the group consisting of an alkali metal silicate and
zinc oxide, from 10 to 40 parts of sodium nitrite and from 10 to 40 parts of a 2,4,6-tri-
substituted phenol having a 4-substituent selected from the group consisting of a
10 substitutable methylene carbon and a substitutable amine, in combination with an
adjuvant present in an amount less than 5 parts, provided that the first polymer is
present in an amount of at least 40 parts in 100 parts of the macrogranules;
combining enough of a second polymer with the macrogranules to produce a
thermoformable mixture having from 0.01 to 2% by weight of the mixture, of an
15 interceptor selected from the group consisting of zinc oxide and a silicate of an alkali
metal, 0.01 to 2% of sodium nitrite and from 0.01 to 2 phr of a 2,4,6-tri-substituted
phenol having a 4-substituent selected from a substitutable methylene carbon and a
substitutable amine, and with from 0.01 to 1% of an inert adjuvant having a hardness
greater than that of the sodium nitrite, wherein the first and second polymer each has a
20 water vapor transmission rate (WVTR) at least as high as that of LDPE, and the
silicate, the sodium nitrite and the adjuvant each have a primary particle size in the
range from 1 µm to 53 µm;
feeding the thermoformable mixture into a thermoforming means; and,
thermoforming an article in which the particles of the sodium nitrite, interceptor and
25 adjuvant are substantially uniformly dispersed.

13. The method of claim 12 wherein the thermoforming means is an extruder and

the article is a laminar sheet of essentially transparent film having smooth surfaces, a thickness in the range from about 0.0125 mm (0.5 mil, or 0.0025") to 0.125 mm (5 mils or 0.005") and has a WVTR at least as high as that of low density polyethylene.

14. The method of claim 12 wherein the thermoforming means is a molding
5 machine and the article has a walls with a cross-section in the range from about 0.025 mm (1 mil or 0.001") to 1.25 mm (50 mil or 0.05") thick.

15. A method of protecting a ferrous object from corrosion in a corrosive atmosphere, comprising,
placing the object in a container formed from a thermoformable synthetic resin
10 having substantially uniformly dispersed therein a combination of volatile corrosion inhibiting ingredients including an interceptor selected from the group consisting of zinc oxide and a silicate of an alkali metal, each present in an amount from 0.01 to 2% by weight of the film; 0.01 to 2% of sodium nitrite; from 0.01 to 2 phr of a 2,4,6-tri-substituted phenol having a 4-substituent selected from a substitutable methylene
15 carbon and a substitutable amine; and from 0.01 to 1% of an inert adjuvant having a hardness greater than that of the sodium nitrite; wherein the silicate, the sodium nitrite and adjuvant each have a primary particle size in the range from 1 μm to 53 μm , and the resin after exposure to an atmosphere including molecular oxygen and from 1 to 100 ppm of an acid gas at a relative humidity of 90% and 37.4°C (100°F) for more
20 than 24 hr, has a water vapor transmission rate (WVTR) which is substantially the same as that of the resin without the volatile corrosion inhibiting ingredients.